Soil moisture variability over South America, as derived from the Global Land Data Assimilation System

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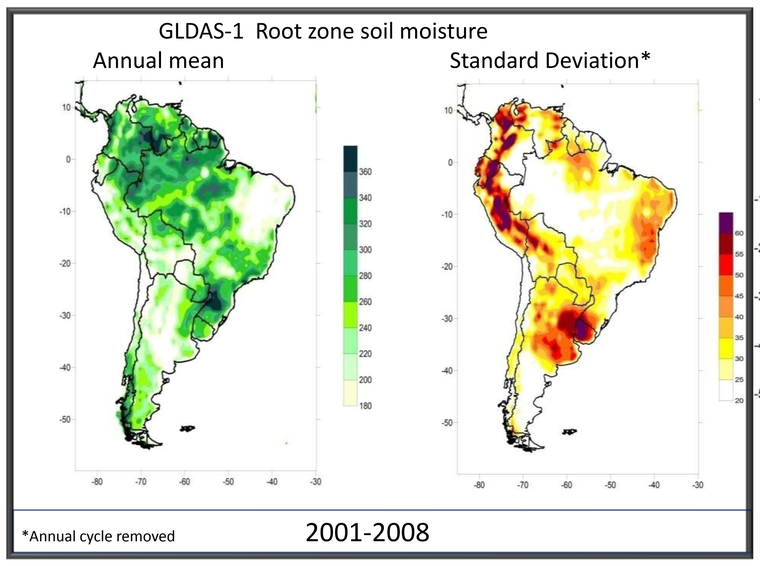
MOTIVATION

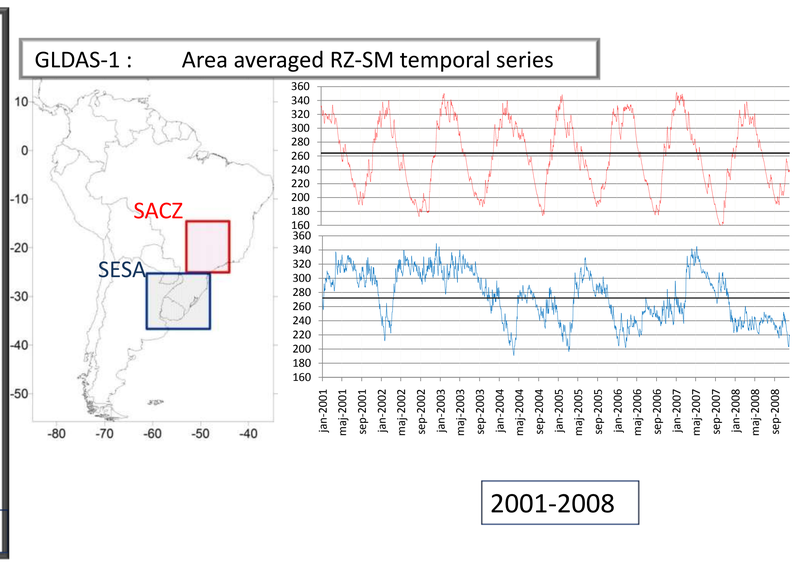
Several studies show the importance of soil moisture and soil states in conditioning atmospheric behavior. Some of them, show significant coupling strength over particular sub-regions in South America, and highlight the potential for enhanced predictability by means of accurate representation of surface forcing, including soil moisture. In spite of this, soil moisture and its variability have not been studied in detail, and the pathways for land-atmosphere interactions remain largely unknown. This is partly explained by the lack of observations that are needed to characterize soil states and soil/vegetation characteristics. The goal of the Global Land Data Assimilation System (GLDAS) is to ingest satellite-and ground - based observational data products, using advanced land surface modeling and data assimilation techniques, in order to generate optimal fields of land surface states and fluxes. This data set is used in this work to explore the **main modes** of **variability** of the **root zone soil moisture** (**RZ-SM**) in South America.

DATA

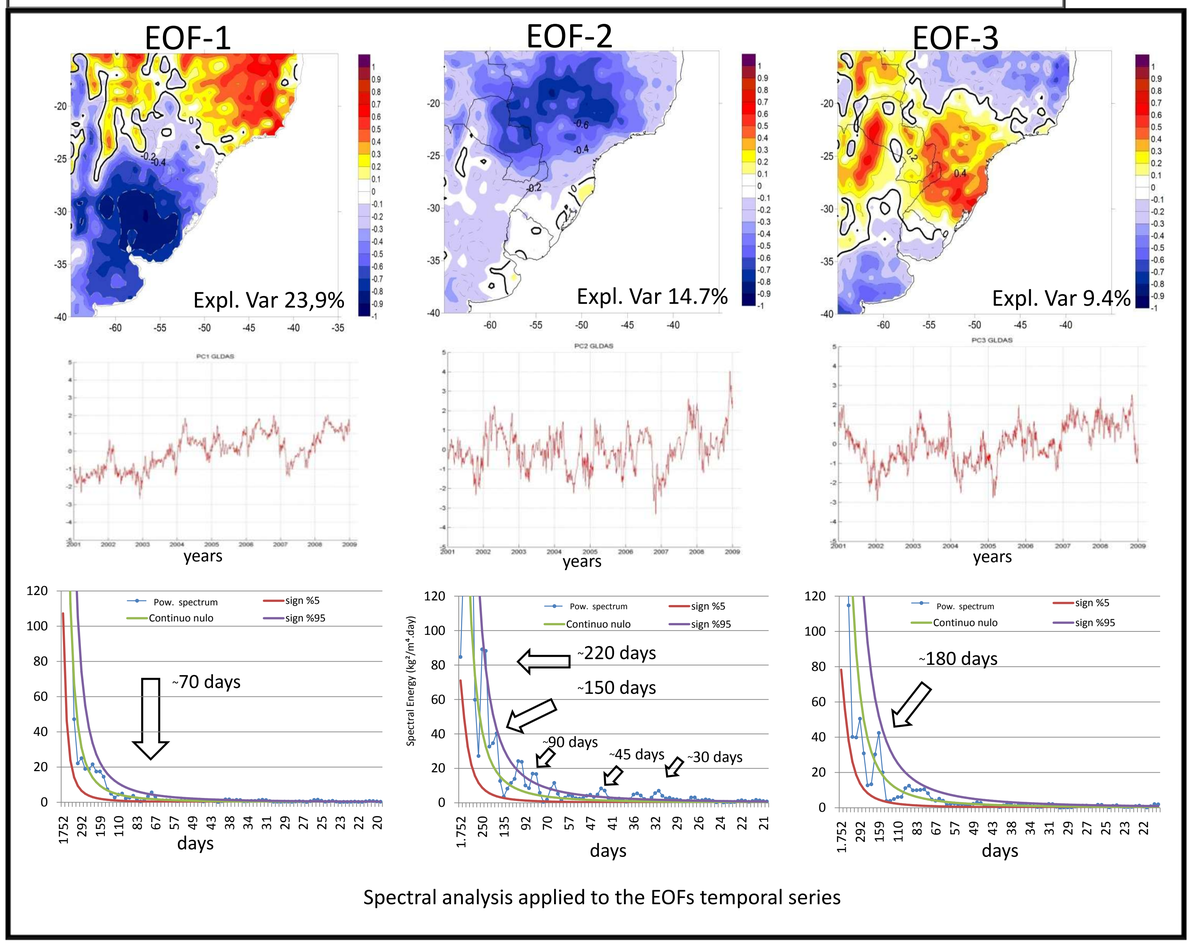
✓daily root zone soil moisture (kg/m²) from GLDAS-1 and GLDAS-2
✓daily precipitation (mm) from GLDAS-1 and GLDAS-2
Period of study:
✓GLDAS-1: 2001-2008
✓GLDAS-2: 1979-2008
Data analysis
✓EOFs were calculated after removing the annual cycle
✓EOFs were also calculated using low and high-pass filtered data to analyze variability with periods longer and shorter than 365 days respectively
Main features of GLDAS-1 and 2

GLDAS - 1	GLDAS 2
LSM: NOAH version 2.7.1 0.25° x 0.25° resolution, daily **Forcing Data**: 2001-present: GDAS +CMAP Rodell et al., 2004.	LSM: NOAH version 2.7.1 1 ° x 1° resolution, dialy /monthly **Forcing Data**: 1948-2008, NCEP–NCAR reanalysis + CRU TS2.0 + GPCP + TRMM Sheffield et al., 2006.

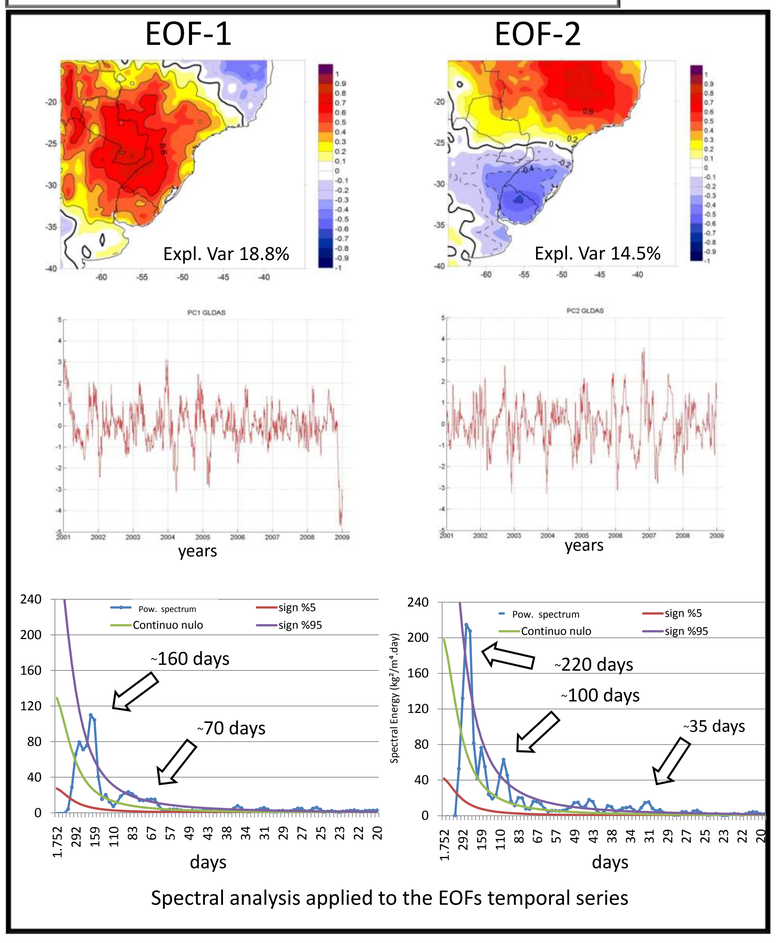




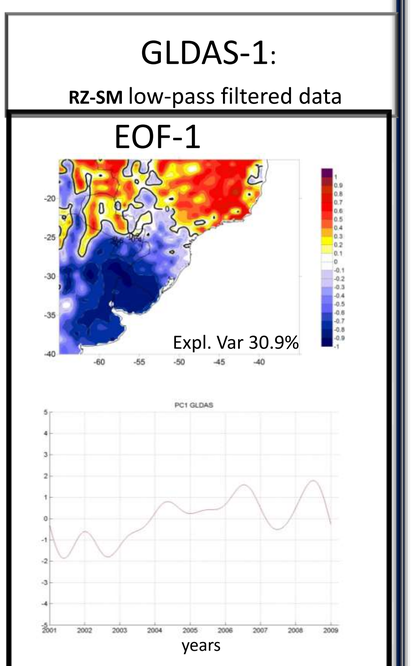
GLDAS-1: EOFs and Spectral analysis of **RZ-SM** anomalies (anual cycle removed)



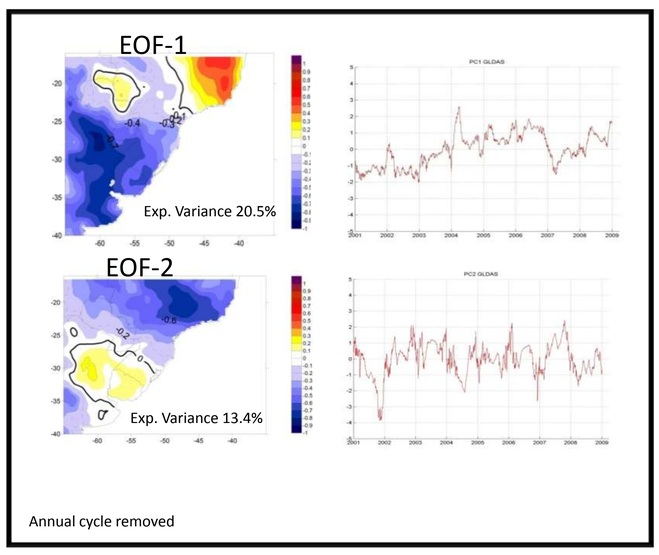
GLDAS-1: **RZ-SM** high-pass filtered data



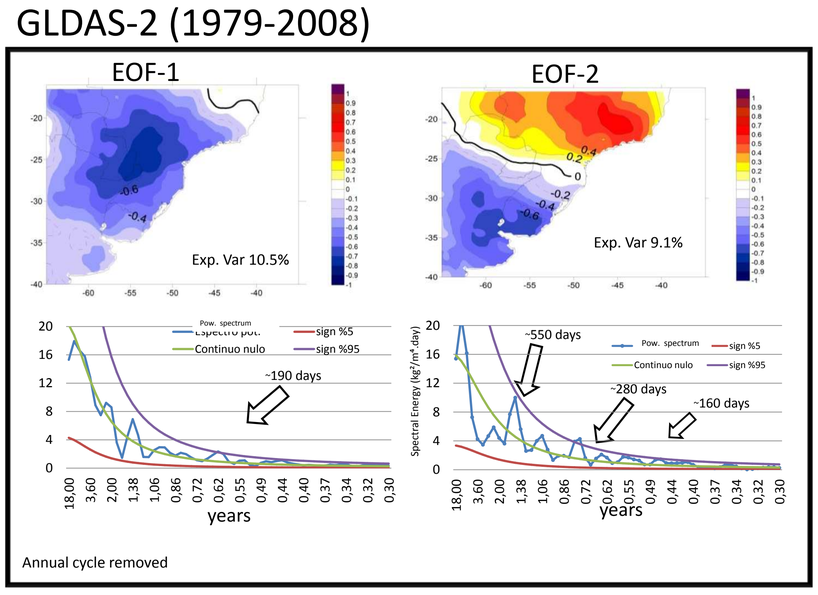
GLDAS-1: **RZ-SM** low-pass filtered data



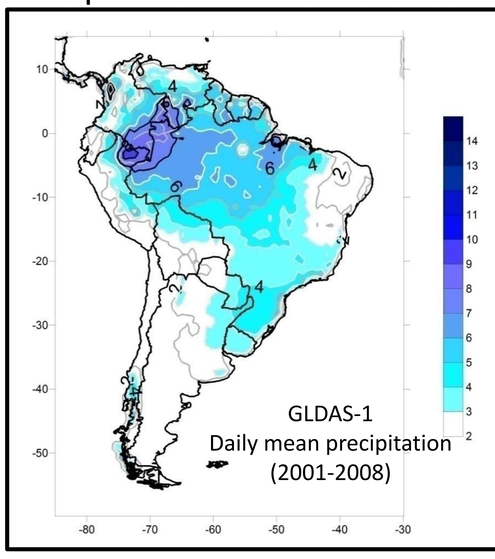
GLDAS-2 (2001-2008)



GLDAS-2 (1979-2008)



Precipitation data differences among the different datasets



Datasets	GLDAS vs GLDAS-2	GLDAS vs Sa22	GLDAS-2 vs Sa22
SESA	0,17	0,48	0,18
SACZ	0,40	0,77	0,38

Correlation of daily area averaged precipitation (2001-2008) among different data sets

Sa22(Liebmann, B., and D. Allured, 2005)

Preliminary results

Root Zone Soil Moisture exhibits areas with **large variability** over South America. In particular, SACZ and SESA sub-regions denote dissimilar behaviors: **SACZ variability** is largely dominated by the **annual cycle** while **SESA** shows important **interannual** changes.
EOF-1 shows a **dipolar signature** with out-of-phase anomalies between tropical an subtropical regions. The **spectrum analysis** of the PC1 temporal variability has a significant **peak** on i**ntraseasonal** scales (at around 70 days). The **second** and **third EOFs** show **several bands** of significant variability, with peaks around **220 days**, and **180** days for PC2 and PC3 respectively. This particular variability behavior motivated our choice of using 365-days low and high pass filters, to better depict sub-annual and interannual soil moisture variability. EOF1 resulted from high-pass filtered data still exhibits peaks at 220 and 160 days, while EOF1 associated to interannual scales reveals **a tendency** towards **reduced soil moisture** over **SESA** within this period.
The comparison between the patterns obtained from **GLDAS-1** and **GLDAS-2,** both over the same period and/or using a longer temporal coverage, shows **important differences** among the leading **EOFs** and their temporal variability. .

References
Liebmann, B., and D. Allured, 2005: Daily precipitation grids for South America. Bull. Amer. Meteor. Soc., 86, 1567-1570.
Rodell et al. 2004: The Global Land Data Assimilation System, Bull. Amer. Meteor. Soc., 85 (3), 381-394, 2004.
Scheffiled et al. 2006 : Development of a 50-Year High-Resolution Global Dataset of Meteorological Forcings for Land Surface Modeling. J. Climate, 19, 3088–3111.

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